

## Evaluating the Capability Maturity Level for the Military Software in Korea

Il-Lo Lee<sup>1</sup>, Suntae Kim<sup>2</sup>, Soojin Park<sup>3</sup>

<sup>1</sup>Defense Agency for Technology and Quality,  
Seoul, South Korea, 215-b@hanmail.net

<sup>2</sup>Department of Computer Engineering, Kangwon National University,  
Kangwon-Province, South Korea, stkim@kangwon.ac.kr

<sup>3</sup>Graduate School of Management of Technology,  
Sogang University, Seoul, South Korea, psjdream@sogang.ac.kr

**Abstract.** This paper summarizes the result of applying MND-ESPAM (the Assessment Model of the Embedded Software Process) into 22 Korean military software companies. The MND-ESPAM is a software process assessment model invented by DtaQ (Institute of Defense Technology and Quality) in 2009. This paper points out a crucial issue of the model, and proposes how to handle the issue. Also, we have simulated our suggestion to show its feasibility.

**Keywords:** MND-ESPAM, Software Process Assessment Model, Korean Military Software

### 1 Introduction

As the weapon systems become more complex and intelligent recently, the importance of the software is more emphasized for their advanced abilities. As an example, the software in the combat airplane F-4 at 1960 was in charge of 8% of all functions, while the software in F-22 Raptor covers 80% of all functions [1]. Due to high dependency for the software, many the internal or external quality issues have been emerged. In order to handle these issues, the SEI (Software Engineering Institute) developed CMMI (Capacity Maturity Model-Integrated) for evaluating the quality of the software development process of an organization[2]. Similarly, the Korean government also has been developed the SP (Software Process) certificate for medium and small scale software companies [3].

As the SP certificate is intended for the non-military software, it was hard to directly apply it into the military software industry that must support an embedded system with high reliability, testability, maintainability and longer development & maintenance period [4]. This motivated DtaQ (Institute of Defense Technology and Quality) to develop the Assessment Model of the Embedded Software

Process(MND-ESPAM) in 2009 [5]. MND-ESPAM is built upon CMMI, SPICE [6][7] and SP, and simplified for Korean military software industry. It is also tailored by applying MND-TMM [8] and IEC 61508 [9] for advanced software testing and safety. However, MND-ESPAM does not have enough applications for its validation so that it is difficult to decide to spread the evaluation model into entire military software in Korea.

This paper reports the statistical results for assessing a software development process of Korean military software companies with MND-ESPAM. The results were gathered from 22 companies, which widely cover the large majority of 27 Korean military software companies. In addition, this paper presents several issues that the evaluation model could not handle, and suggests approaches to improving the model. This paper can contribute to establish software-process related policies for the military software, and also it is used the MND-ESPAM to be settled down in Korean defense industry.

## 2 Background: MND-ESPAM

MND-ESPAM is a software process assessment model for Korean military software [5]. It has been created by extracting common process areas from CMMI, SPICE and SP, and incorporating it with process areas from MND-TMM for enforcing reliable testing into the process, and those from IEC 61508 for guaranteeing software safety. In addition, it is aligned with the Defense Software Development Guideline from Korean DAPA (Defense Acquisition Program Administration) which plays a key role to orchestrate military projects in Korea.

In the MND-ESPAM, the capability of the organization of classified into four level *Amateur (Level 1)*, *Managed (Level 2)*, *Defined (Level 3)* and *Improved (Level 4)* as shown in Fig 1. The *Amateur* level indicates the maturity level for an organization which has non-predictable and uncontrolled software process. The *Managed* level is the extent of maturity for an organization that establishes diverse project-specific software process or sometimes carries out some of the process after completing a project, while the *Defined* level is for an organization which defines a standard software process for entire software projects. The *Improved* level represents the maturity of an organization where most of the processes are quantitatively measured and controlled.

| Level 1<br>(Amateur) | Level 2<br>(Managed)  | Level 3<br>(Defined)   | Level 4<br>(Improved)   |
|----------------------|---|--|---|
| N/A                  | <i>Management</i><br>- Project Planning<br>- Project Control<br>- Co-worker Management<br><i>Development</i><br>- Requirement Management<br><i>Support</i><br>- Measurement and Analysis<br>- Configuration Management<br>- Quality Assurance | <i>Development</i><br>- Requirement Analysis/Design<br>- Implementation/Integration<br>- Install and Acceptance Support<br>- Verification<br>- Test Readiness<br><i>Organization</i><br>- Organization Process Management<br>- Resource Management<br>- Reuse Management | <i>Management</i><br>- Quantitative Project Management<br><i>Organization</i><br>- Organization Performance Management<br>- Organization Process Innovation |

Fig. 1. MND-ESPAM Maturity Levels

Each level contains key process area categorized as *Management*, *Organization*, *Development*, and *Support*, each of which contains process areas such as *Requirement Management*, *Quality Assurance* and so on suitable for each level (see Fig 1). After establishing the assessment model, software practitioners have checked its validity in terms of comprehensiveness, applicability, and effectiveness.

### 3. Evaluating Capability Maturity Level for Military Software

#### 3.1 Subjects of the Survey

22 of 27 military software development companies in Korean defense industries were involved in this research by responding our questionnaire for one month since Oct. 14 at 2011. In order to guarantee the reliability of survey, we asked the quality assurance team in charge of maintaining software process in their organization for responding the questionnaire. The companies involved in this survey consists of 9 large-scale companies (41%) and 13 small/medium size companies (59%), which had at least 10 year experience in this area. Also, 15 companies (68%) obtained software process certificates including 6 companies with CMMI level 2, 2 companies with CMMI level 3, 2 companies with CMMI level 4, and 5 companies GS (Good Software) or ISO certificates respectively.

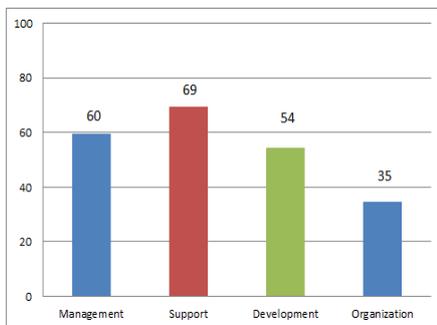
#### 3.2. Design of the Survey

The questionnaire is composed of 123 questions for checking the maturity level defined in the Level 2, 155 questions for the Level 3, and 45 questions for the Level 4. Table 1 shows one of the questions for checking the level of project scoping of the organization. The responder responses to each question with one of the FI (Fully Implemented), PI (Partly Implemented), NI (Not Implemented), and N/A (not applied to the project). In addition, the output instances of the process activities are exemplified for precise understanding. The replies FI, PI and NI are quantified into

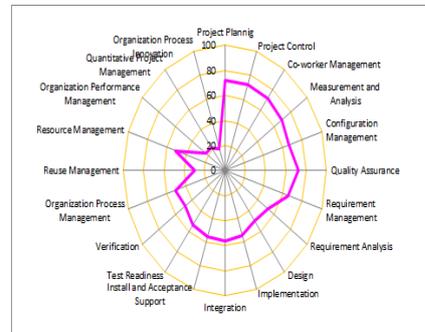
100, 50 and 0 points respectively. Thus, the organization with over 80 points on average for each process is assessed as ‘Sufficient’, while the one under 80 points on average is evaluated as ‘Insufficient’.

**Table 1.A** Question for Checking Project Planning

| Process Area     | Activity        | No . | Inquiry  | Reply |    |    |     | Output Instance |
|------------------|-----------------|------|--|-------|----|----|-----|-----------------|
|                  |                 |      |  | FI    | PI | NI | N/A |                 |
| Project Planning | Project Scoping | 1    | Do you define fine-grained tasks after depicting the Work-Breakdown Structure (WBS)? |       |    |    |     | WBS             |



**Fig. 2.** Average Points of Each Category



**Fig. 3.** Points of Each Process Area

### 3.3. Survey Results

The survey results say that 11 (50%), 7 (32%), 3 (14%) and 1 (4%) of 22 companies were classified into the Level 1, 2, 3, and 4 respectively. This is considered as a half of the organizations are classified into Level 1, and another half of the organizations are evaluated as Level 2, 3 and 4. Particularly, all organizations classified as Level 2~4 were turn out to be certificate holders of upper level 2 of CMMI. Two companies having CMMI Level 5 satisfy the requirements of the Level 4, while most of the companies obtained low points for the Level 4 questions.

When it comes to projecting the results in terms of company scale, 8 of 9 large-scale companies were evaluated as over Level 2, while 10 of 13 medium and small scale companies were classified into the Level 1. The average point of all organizations was 70 points out of 100 in the Level 1, 50 points in the Level 2, 21 points in the Level 3, 21 points in the Level 4. When classifying the results in terms of categories, the points for the *Support* category are relatively higher than other categories (see Figure 2).

Analyzing each category in more detail indicates that the organizations were earned 65.1 and 66.3 in the *Requirement Management*, *Configuration Management* process

area respectively, and also they got 30.1, 47.8 and 49.4 points for the *Reuse Management*, *Verification*, and *Design* process area respectively. On the other hand, the scores for the *Project Control* (72.2) in level 2 and *Integration* (56.1) in level 3 were relatively higher than others. Specially, they got very low points for the *Reuse Management* process area as shown in Figure 3.

### 3.4. Improvement point of MND-ESPAM

The *Reuse Management* process area has been evaluated as very low (about 20 points), which is a similar score with process areas from the Level 4. This causes 5 companies to be evaluated as the Level 2. They might be upgraded into Level 3 or 4 if the *Reuse Management* is relocated into the evaluation criteria of Level 4. After simulating relocation of the process area into the Level 4, 4 organizations can be upgraded into the Level 3 from the Level 2, 1 organization can be moved into the Level 4 from the Level 2. As a result of this simulation, totally 9 companies can acquire over the Level 3, compared with 4 companies with the original MND-ESPAM. This (9 companies with the over MND-ESPAM Level 3) can be align with the result with the commercial certificates (10 companies with the over CMMI level 3).

## 4 Conclusion

This paper has presented the survey and its result on applying MND-ESPAM software assessment model into military software companies in Korea. The survey presented the applicability of the assessment model to the industry and some of the issues and improvement of the model. For the survey, we requested 22 of 27 military software companies to response the questionnaire and statically analyzed the result. As the future work, we are planning to enhance the MND-ESP assessment model for software security.

**Acknowledgement.** This research was supported by Next-Generation Information Computing Development Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Plannig (No. 2012M3C4A7033348)

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